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Research article/Araştırma makalesi

Floristic properties and life forms of *Liquidambar orientalis* forests naturally distributed in Muğla (Turkey) province

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Abstract

The objective of this study was to determine the floristic diversity of *Liquidambar orientalis* Mill. (Sweetgum) forests in Muğla province. The research areas were seven different locations in Muğla province. In this study, during 2010-2012 periods, while evaluating the collected 613 plant specimens; 60 family, 150 genera, 212 species, 8 subspecies and 6 variety were identified. The total number of taxa is 226. The number of endemic plants is 6 (2.65%). The distribution rates of taxa into phytogeographical regions are as follows: Mediterranean elements 56 (24.77%), Irano-Turanian elements 3 (1.32%), Euro-Siberian elements 26 (11.50%) and cosmopolits 141 (62.38%).

Key words: flora, *Liquidambar orientalis*, life forms, Muğla, Turkey

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Muğla ilinde doğal yayılış gösteren *Liquidambar orientalis* ormanlarının hayat formları ve floristik özellikleri

Özet

Bu çalışma, Muğla ilinde bulunan *Liquidambar orientalis* Mill. (Sığla) ormanlarının floristik çeşitliliğinin belirlenmesi amacıyla yapılmıştır. Araştırma alanları Muğla il sınırları içerisinde 7 farklı lokalitede bulunmaktadır. Bu araştırmada, 2010-2012 yılları arasında toplanan 613 bitki örneğinin değerlendirilmesi ile 60 familya, 150 cins, 212 tür, 8 alttür ve 6 varyete tespit edilmiştir. Toplam takson sayısı 226'dır. Endemik bitkilerin sayısı 6 (%2.65) 'dır. Taksonların fitocoğrafik bölgelere dağılım oranları şu şekildedir: Akdeniz elementleri 56 (%24.77), İran-Turan elementleri 3 (%1.32), Avrupa-Sibirya elementleri 26 (%11.50) ve geniş yayılışlı taksonların sayısı 141 (%62.38)' dir.

Anahtar kelimeler: flora, *Liquidambar orientalis*, hayat formları, Muğla, Türkiye.

1. Introduction

The genus Liguidambar L. appertaining to the family of Hamamelidaceae is dispersed an abundant diversity expanding from north America to east Asia (Hoey and Parks, 1991). Liquidambar (sweetgum) has four main species. These are *L. formosana*, *L. acalycina*, *L. styraciflua* and *L. orientalis*. *L. formosana and L. acalycina* are dispersed in central and southern China, whereas *L. styraciflua* is found in eastern north America (Bogle, 1986). On the other hand, *L. orientalis* is commonly known as "oriental sweetgum" is found In the Mediterranean basin and have only one species and it is a relict-endemic species for the southwestern Anatolia and island of Rhodes (Davis, 1982). Additionally, *Liquidambar orientalis* Mill. is found out in southwest Anatolia espacially Marmaris, Köyceğiz, Fethiye, Çine, Bucak, Isparta and Antalya (Pamukçuoğlu, 1964; Çelik et al., 1997).

Liquidambar orientalis forests are important for ecological and economic. There have been very few researches about the morphology, anatomy, palynology and phytosociology of this ecological and economic important species (Efe, 1987; Efe and Dirik, 1992; Akman et al., 1993 and Vural et al., 1995).The various aspects of this forests are highlighted but floristic features of this forests are not mentioned enough.

The research areas are located within the boundaries of Muğla province (Figure 1). Research areas are situated on south, south west and south east of the city center. Ula-Kizilyaka Liquidambar forest is at about between 97-102 m

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altitude, Çetibeli Liquidambar forest (oriental sweetgum) is at about between 29-35 m altitude, Değirmenyanı Liquidambar forest is at about between 16-25 m altitude, Köyceğiz -Toparlar Liquidambar forest is at about between 10-15 m altitude, İnlice Liquidambar forest is at about between 5-10 m altitude, Günlüklü bay Liquidambar forest is at about between 0-2 m altitude, Fethiye - Yanıklar Liquidambar forest is at about between 7-16 m altitude. This study areas, which lies within square C2 according to the grid square system given by Davis (1965-1988), are located within the Mediterranean phytogeographical zone.

Figure 1. Map of research areas

There are 3 general soil groups in the study areas; colluvial soils, alluvial soils and limeless brown soils. The Muğla province is under the effect of Mediterranean climate.

In Marmaris, the maximum mean temperature is 28.2 °C; in Köyceğiz, the maximum mean temperature is 28.7 °C; in Dalaman, the maximum mean temperature is 27.5 °C and in Fethiye the maximum mean temperature is 27.5 °C in July and August. The lowest mean temperature are in January and February, with a temperature of 3.9 °C in Köyceğiz. The minimum mean temperature (m) is 3.9 °C in January in Köyceğiz.

Annual rainfall in Marmaris is 1179.6 mm, in Köyceğiz is 1086.0 mm, in Dalaman is 981.0 mm, in Fethiye is 830.7 mm. Most of the rain falls in the autumn, winter and spring. Summer rainfall is minimal. The rainiest months are November, December and January while the driest months are the June, July and August.

2. Materials and methods

In total, 611 plant specimens from research areas were periodically collected between November 2010 and May 2012. All specimens were pressed and dried according to the standard herbarium methods. Identifications were made using Flora of Turkey and the East Aegean Islands (Davis 1965-1988; Güner et al., 2000).

In the floristic list of this article, the following details are given: family name, species name and the author(s), locality of the plant, collector number. The endemic species are categorized according to IUCN (2001) and Ekim et al. (2000). All herbarium specimens are stored in the herbarium of Muğla Sıtkı Koçman University, Muğla.

3. Results

In this study, 611 plants were collected and 226 taxa belonging to 60 families were identified from research areas. The Gymnosperms comprised 2 species in 2 families and the angiosperms comprised 218 species, of which 53 Angiospermae taxa were Monocotyledonae and 165 were Dicotyledonae.

The distribution of plant taxa according to phytogeographical regions is as follows: Mediterranean 56 (24.77%); Euro-Siberian, 26 (11.50%); Irano-Turanian, 3 (1.32%).

All species are categorized with reference to the Raunkiaer life-form category. The life form analysis which useful tool for describing vetetation are a extensively used Raunkiaer (1934). Therophytes are the dominant life form in this study, which constitute 103 taxa (45.57%) of the flora, followed by Hemicryptophytes (56 taxa, 24.78%), Cryptophytes (40 taxa, 17.70%), Phanerophytes (26 taxa, 11.5%) and Chamaephytes (1 taxon, 0.45%) (Figure 2).

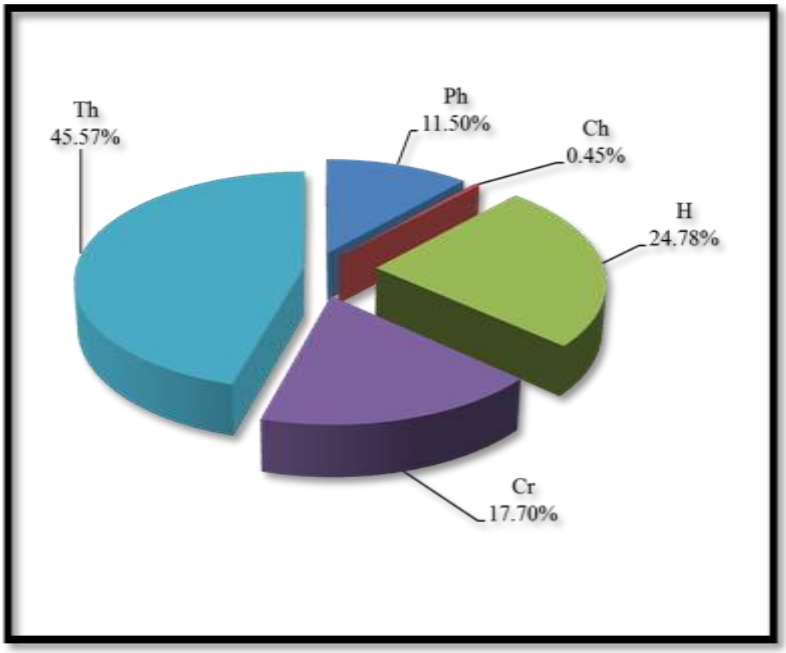

Figure 2. Proportinal percentage of life forms for the research areas

Abbreviations:
Th: Therophyte
H: Hemicryptophyte
Ch: Chamaephyte
Ph: Phanerophyte
Cr: Cryptophyte

The abbreviations used in text, the localities of research areas and in the floristic list are as follows:
Medit.: Mediterranean
E. Medit.: East Mediterranean
Ir.-Tur: Irano-Turanian
Euro.-Sib.: Euro-Siberian
End.:Endemic
K.A.: Kenan AKBAŞ
Loc.: Locality
m : Meter
N: North
E: East.

3.1. Localities of research areas

Loc.1: Muğla; Ula-Kızılyaka district, *Liquidambar orientalis* forest, N 37° 00′ 32.53′′ E 028° 27′ 31.51′′, 97 -102 m
Loc.2: Muğla; Muğla-Marmaris way, 42 km, Çetibeli district, Çamlı Village, *L. orientalis* forest, N 36° 58′ 07.04′′ E 28° 17′ 03.98′′, 29-35 m
Loc.3: Muğla; Marmaris-Datça way, Değirmenyanı district, *L. orientalis* forest, N 36° 50′ 07.60′′ E 28° 08′ 44.46′′, 16-25 m
Loc.4: Muğla; Köyceğiz-Toparlar district, *L. orientalis* forest, N 36° 59′ 37,00′′ E 28° 38′ 50,00′′ , 10-15 m
Loc.5: Muğla; İnlice, Günlüklü Street, *L. orientalis* forest, N 36° 44′ 13,43′′ E 28° 58′ 27,56′′, 5-10 m
Loc.6: Muğla; Muğla-Fethiye way, 108 km, Günlüklü bay area, *L. orientalis* forest, N 36° 44′ 4,49′′ E 28° 55′ 7,14′′, 0-2 m
Loc.7: Muğla; Fethiye-Yanıklar district, *L. orientalis* forest, N 36° 41′ 25.88′′ E 29° 03′ 44.51′′, 7-16 m

3.2. The floristic list

PTERIDOPHYTA
EQUISETACEAE
Equisetum hyemale L.
Loc.2, K.A. 045; Loc.7, K.A. 100.
OPHIOGLOSSACEAE
Ophioglossum vulgatum L.
Loc.1, K.A. 441, 607; Loc.5, K.A. 599; Loc.4, K.A. 601; Loc.2, K.A. 608.
SINOPTERIDACEAE
Cheilanthes persica (Bory) Kuhn
Loc.6, K.A. 344.
ADIANTACEAE
Adiantum capillus-veneris L.
Loc.7, K.A. 104; Loc.5, K.A. 131.
ASPLENIACEAE
Ceterach officinarum DC.
Loc.6, K.A. 345.
POLYPODIACEAE
Polypodium australe Fée
Loc.6, K.A. 095.
SPERMATOPHYTA
GYMNOSPERMAE
PINACEAE
Pinus brutia Ten.
Loc.4, K.A. 061; Loc.3, K.A. 079; Loc.1, K.A. 116.
EPHEDRACEAE
Ephedra campylopoda C. A. Meyer
Loc.4, K.A. 521.
ANGIOSPERMAE
DICOTYLEDONES
RANUNCULACEAE
Clematis cirrhosa L.
Loc.2, K.A. 577. Medit.

Ranunculus neopolitanus Ten.
Loc.4, K.A. 122; Loc.1, K.A. 223; Loc.7, K.A. 264a; Loc.2, K.A. 303.
R. constantinopolitanus (DC.) d'Urv.
Loc.2, K.A. 161; Loc.5, K.A. 228.
R. marginatus d'Urv. var. **trachycarpus** (Fisch.& Mey.) Azn.
Loc.1, K.A. 058; Loc.4, K.A. 184; Loc.6, K.A. 242; Loc.7, K.A. 263, 267.
R. ophioglossifolius Vill.
Loc.7, K.A. 264; Loc.2, K.A. 307; Loc.4, K.A. 392.
R. ficaria L. subsp. **ficariiformis** Rouy & Fouc.
Loc.3, K.A. 147; Loc.2, K.A. 162; Loc.1, K.A. 593.
R. trichophyllus Chaix
Loc.1, K.A. 119, 120, 222; Loc.3, K.A. 155; Loc.2, K.A. 168; Loc.4, K.A. 183, 600.
PAPAVERACEAE
Papaver gracile Boiss.
Loc.4, K.A. 395, 396; Loc.3, K.A. 404. E. Medit.
P. rhoeas L.
Loc.3, K.A. 434.
Fumaria officinalis L.
Loc.1, K.A. 324.
BRASSICACEAE (CRUCIFERAE)
Raphanus raphanistrum L.
Loc.4, K.A. 199, 200, 201; Loc.7, K.A. 266; Loc.3, K.A. 290; Loc.2, K.A. 302.
Calepina irregularis (Asso)Thell.
Loc.4, K.A. 186.
Capsella rubella Reuter
Loc.4, K.A. 391.
Nasturtium officinale R. Br.
Loc.5, K.A. 233.
Cardamine hirsuta L.
Loc.3, K.A. 107; Loc.2, K.A. 114; Loc.1, K.A. 121; Loc.4, K.A. 127; Loc.5, K.A. 130; Loc.7, K.A. 141; Loc.6, K.A. 255.
CARYOPHYLLACEAE
Arenaria luschanii McNeill
Loc.1, K.A. 450. End. E. Medit.
Stellaria media (L.) Vill. subsp. **pallida** (Dumort.) Asch. & Graebn.
Loc.2, K.A. 164, 312; Loc.4, K.A. 182; Loc.1, K.A. 205.
S. media (L.) Vill. subsp. **postii** Holmboe
Loc.3, K.A. 153, 287; Loc.6, K.A. 253, 254, 351.
Cerastium brachypetalum Pers. subsp. **roeseri** (Boiss. & Heldr.) Nyman
Loc.4, K.A. 181; Loc.1, K.A. 212; Loc.6, K.A. 249; Loc.7, K.A. 265.
Moenchia mantica (L.) Bartl. subsp. **caerulea** (Boiss.) A.R.Clapham
Loc.1, K.A. 211.
Silene gallica L.
Loc.4, K.A. 378.
POLYGONACEAE
Polygonum salicifolium Brouss.
Loc.5, K.A. 053, 137, 227, 538; Loc.7, K.A. 144; Loc.4, K.A. 504, 584.
P. aviculare L.
Loc.4, K.A. 476.
P. pulchellum Lois.
Loc.4, K.A. 511, 578, 581.
Rumex conglomeratus Murray
Loc.4, K.A. 386, 475; Loc.2, K.A. 407, 436; Loc.3, K.A. 431; Loc.1, K.A. 451; Loc.7, K.A. 455; Loc.5, K.A. 465.
R. pulcher L.
Loc.4, K.A. 371.

AMARANTHACEAE
Amaranthus viridis L.
Loc.1, K.A. 015.

MOLLUGINACEAE
Glinus lotoides L.
Loc.1, K.A. 492.
HYPERICACEAE (GUTTIFERAE)
Hypericum tetrapterum Fries
Loc.2, K.A. 555, 563, 595.
H. perforatum L.
Loc.4, K.A. 478.

MALVACEAE
Althaea officinalis L.
Loc.4, K.A. 520.
GERANIACEAE
Geranium lucidum L.
Loc.2, K.A. 166, 304; Loc.4, K.A. 189, 373,374; Loc.1, K.A. 215; Loc.5, K.A. 225; Loc.3, K.A. 329.
G. purpureum Vill.
Loc.5, K.A. 136; Loc.4, K.A. 188; Loc.6, K.A. 257; Loc.7, K.A. 272; Loc.3, K.A. 279; Loc.2, K.A. 314, 412.
G. molle L. subsp. **molle**
Loc.6, K.A. 258, 352.
Erodium moschatum (L.) L' Hérit.
Loc.5, K.A. 226. Medit.
OXALIDACEAE
Oxalis pes-caprae L.
Loc.4, K.A. 196
O. corniculata L.
Loc.4, K.A. 129, 394; Loc.7, K.A. 261.
VITACEAE
Vitis sylvestris Gmelin
Loc.3, K.A. 430.
FABACEAE (LEGUMINOSAE)
Cercis siliquastrum L. subsp. **siliquastrum**
Loc.2, K.A. 576.
Vicia villosa Roth subsp. **eriocarpa** (Hausskn.) P. W. Ball.
Loc.3, K.A. 292.
V. pubescens (DC.) Link.
Loc.5, K.A. 362. Medit.
V. hybrida L.
Loc.4, K.A. 393.
V. sativa L. subsp. **nigra** (L.) var. **nigra**
Loc.5, K.A. 359.
Ononis spinosa L. subsp. **leiosperma** (Boiss.) Sirj.
Loc.4, K.A. 513, 583; Loc.1, K.A. 551.
Trifolium repens L. var. **giganteum** Lag.-Foss.
Loc.7, K.A. 336; Loc.1, K.A. 421.
T. repens L. var. **repens**
Loc.7, K.A. 143; Loc.4, K.A. 197; Loc.6, K.A. 259.
T. nigrescens Viv. subsp. **petrisavii** (Clem.) Holmboe
Loc.3, K.A. 291.
T. campestre Schreb.
Loc.3, K.A. 283; Loc.7, K.A. 337; Loc.6, K.A. 353; Loc.4, K.A. 382; Loc.1, K.A. 444.
T. resupinatum L. var. **resupinatum**
Loc.2, K.A. 310.
T. resupinatum L. var. **microcephalum** Zoh.
Loc.4, K.A. 185; Loc.3, K.A. 288; Loc.1, K.A. 420.
T. tomentosum L.
Loc.7, K.A. 335.
Medicago polymorpha L. var. **vulgaris** (Benth.) Shinners
Loc.4, K.A. 180, 372; Loc.6, K.A. 238.
Lotus corniculatus L. subsp. **tenuifolius** L.

Loc.4, K.A. 487, 505, 506; Loc.1, K.A. 490.
ROSACEAE
Rubus sanctus Schreb.
Loc.1, K.A. 028, 488; Loc.5, K.A. 532.
Potentilla reptans L.
Loc.7, K.A. 458; Loc.5, K.A. 463.
Geum urbanum L.
Loc.2, K.A. 409. Euro.-Sib.
Crataegus monogyna Jacq. subsp. **monogyna**
Loc.4, K.A. 171, 508, 519.
C. monogyna Jacq. subsp. **azarella** (Gris.) Franco
Loc.4, K.A. 069.
MYRTACEAE
Myrtus communis L. subsp. **communis**
Loc.7, K.A. 051; Loc.3, K.A. 082; Loc.6, K.A. 096.
LYTHRACEAE
Lythrum salicaria L.
Loc.5, K.A. 541. Euro.-Sib.
ONAGRACEAE
Epilobium hirsutum L.
Loc.4, K.A. 500; Loc.5, K.A. 533.
CALLITRICHACEAE
Callitriche truncata Guss. subsp. **truncata**
Loc.7, K.A. 596; Loc.4, K.A. 602, 603. Medit.
HAMAMELIDACEAE
Liquidambar orientalis Mill. var. **orientalis**
Loc.7, K.A. 270; Loc.5, K.A. 363; Loc.6, K.A. 461; Loc.3, K.A. 586. End.
L. orientalis Mill. var. **integriloba** Fiori
Loc.2, K.A. 298. End. E. Medit.
APIACEAE (UMBELLIFERAE)
Scandix pecten-veneris L.
Loc.4, K.A. 176; Loc.3, K.A. 604.
Berula erecta (Huds.) Coville
Loc.5, K.A. 462.
Oenanthe pimpinelloides L.
Loc.3, K.A. 277a; Loc.2, K.A. 305; Loc.1, K.A. 414.
Apium nodiflorum (L.) Lag.
Loc.7, K.A. 457; Loc.5, K.A. 467.
Falcaria falcarioides (Bornm. & Wolff) Wolff
Loc.4, K.A. 493, 528, 592; Loc.3, K.A. 572.
Tordylium apulum L.
Loc.4, K.A. 398. Medit.
Torilis leptophylla (L.) Reichb.
Loc.6, K.A. 348; Loc.4, K.A. 390.
Daucus carota L. subsp. **carota**
Loc.1, K.A. 019; Loc.2, K.A. 40, 41.
D. carota L. subsp. **maritimus** (Lam.) Batt.
Loc.5, K.A. 090, 093.
D. broteri Ten.
Loc.5, K.A. 132; Loc.4, K.A. 507. Medit.
D. guttatus Sm.
Loc.1, K.A. 018, 024, 025; Loc.2, K.A. 035; Loc.4, K.A. 066.
ARALIACEAE
Hedera helix L.
Loc.4, K.A. 002, 064, 071; Loc.1, K.A. 026; Loc.3, K.A. 081; Loc.5, K.A. 084, 085; Loc.6, K.A. 097; Loc.7, K.A. 101.
VALERIANACEAE
Valeriana dioscoridis Sm.
Loc.3, K.A. 151. E. Medit.
DIPSACACEAE
Knautia integrifolia (L.) Bert. var. **bidens** (Sm.) Borbás
Loc.6, K.A. 346, 347; Loc.4, K.A. 369; Loc.3, K.A. 428, 429. E. Medit.
ASTERACEAE (COMPOSITAE)
Inula viscosa (L.) Aiton
Loc.2, K.A. 558. Medit.
Pulicaria dysenterica (L.) Bernh.
Loc.4, K.A. 503; Loc.7, K.A. 547; Loc.2, K.A. 556, 561.
Aster subulatus Michaux
Loc.1, K.A. 014, 021, 059; Loc.2, K.A. 031, 043; Loc.4, K.A. 070, 501, 590; Loc.7, K.A. 542.
Conyza canadensis (L.) Cronquist
Loc.2, K.A. 029.
C. bonariensis (L.) Cronquist
Loc.2, K.A. 033.
Bellis annua L.
Loc.3, K.A. 109. Medit.
B. perennis L.
Loc.1, K.A. 020, 057; Loc.4, K.A. 074; Loc.2, K.A. 076, 163; Loc.7, K.A. 102. Euro.-Sib.
Senecio aquaticus Hill. subsp. **aquaticus**
Loc.2, K.A. 566. Euro.-Sib.
S. aquaticus Hill. subsp. **barbareifolius** (Krock.) Wimm. & Grab.
Loc.2, K.A. 047; Loc.4, K.A. 068, 524.
S. vernalis Waldst. & Kit.
Loc.3, K.A. 110, 152, 154, 285; Loc.2, K.A. 113.
Cirsium vulgare (Savi) Ten.
Loc.4, K.A. 510; Loc.7, K.A. 545.
Carduus pycnocephalus L. subsp. **albidus** (M.Bieb.) Kazmi
Loc.4, K.A. 365.
C. pycnocephalus L. subsp. **arabicus** (Jacq. ex Murray)
Loc.5, K.A. 529, 535. Medit.
Leontodon tuberosus L.
Loc.1, K.A. 016, 022; Loc.6, K.A. 055; Loc.4, K.A. 072, 073; Loc.3, K.A. 275. Medit.
Picris hieracioides L.
Loc.1, K.A. 010, 017; Loc.5, K.A. 133, 530, 540; Loc.4, K.A. 514, 591; Loc.7, K.A. 546; Loc.3, K.A. 573, 574. Euro.-Sib.
Rhagadiolus stellatus (L.) Gaertner var. **stellatus**
Loc.2, K.A. 315; Loc.4, K.A. 377.
R. stellatus (L.) Gaertner var. **edulis** (Gaertner) DC.
Loc.1, K.A. 325; Loc.6, K.A. 350.
Sonchus asper (L.) Hill subsp. **glaucescens** (Jord.) Ball
Loc.2, K.A. 038, 039, 300, 301; Loc.1, K.A. 323, 418; Loc.3, K.A. 401.
Taraxacum crepidiforme DC. subsp. **crepidiforme**
Loc.2, K.A. 160. Ir.-Tur.
T. scaturiginosum G. Hagl.
Loc.1, K.A. 115, 216.
Crepis foetida L. subsp. **commutata** (Spreng.) Babc.
Loc.3, K.A. 286.
C. sancta (L.) Babc.
Loc.6, K.A. 349.
C. micrantha Czer.
Loc.3, K.A. 423, 424; Loc.1, K.A. 443; Loc.6, K.A. 460; Loc.4, K.A. 474.
CAMPANULACEAE
Campanula drabifolia Sm.
Loc.4, K.A. 380. E. Medit.
Legousia speculum-veneris (L.) Chaix
Loc.6, K.A. 354. Medit.
PRIMULACEAE
Cyclamen coum Mill. var. **coum**
Loc.3, K.A.111.
Lysimachia dubia Sol.
Loc.3, K.A. 432; Loc.5, K.A. 466; Loc.4, K.A. 471, 527. E. Medit.
L. linum-stellatum L.
Loc.4, K.A. 191. Medit.
Anagallis arvensis L. var. **arvensis**

Loc.7, K.A. 262; Loc.2, K.A. 313; Loc.3, K.A. 402; Loc.1, K.A. 447.
A. arvensis L. var. **caerulea** (L.) Gouan
Loc.6, K.A. 243; Loc.3, K.A. 280; Loc.2, K.A. 311; Loc.4, K.A. 387.
Samolus valerandi L.
Loc.2, K.A. 408, 567; Loc.7, K.A. 453; Loc.5, K.A. 468; Loc.4, K.A. 481.
STYRACACEAE
Styrax officinalis L.
Loc.7, K.A. 332; Loc.6, K.A. 355.
OLEACEAE
Fraxinus angustifolia Vahl subsp. **angustifolia**
Loc.4, K.A. 515.
Phillyrea latifolia L.
Loc.2, K.A. 032; Loc.4, K.A. 062; Loc.6, K.A. 098. Medit.
APOCYNACEAE
Nerium oleander L.
Loc.4, K.A. 009; Loc.2, K.A. 044; Loc.5, K.A. 088. Medit.
ASCLEPIADACEAE
Periploca graeca L. var. **vestita** Rohlena
Loc.4, K.A. 383. E. Medit.
GENTIANACEAE
Centaurium erythraea Rafn subsp. **erythraea**
Loc.4, K.A. 473; Loc.2, K.A. 594. Euro.-Sib.
C. erythraea Rafn subsp. **rhodense** (Boiss. & Reuter) Melderis
Loc.1, K.A. 549. Medit.
C. erythraea Rafn subsp. **rumelicum** (Velen.) Melderis
Loc.4, K.A. 484. Medit.
BORAGINACEAE
Myosotis cadmaea Boiss.
Loc.4, K.A. 195. E. Medit.
M. sicula Guss.
Loc.1, K.A. 221, 316; Loc.4, K.A. 379.
Cynoglossum creticum Mill.
Loc.7, K.A. 340; Loc.5, K.A. 469.
SOLANACEAE
Solanum nigrum L. subsp. **nigrum**
Loc.4, K.A. 005; Loc.2, K.A. 034, 565, 575; Loc.5, K.A. 091, 092; Loc.7, K.A. 106;
S. nigrum L. subsp. **schultesii** (Opiz) Wessely
Loc.4, K.A. 004; Loc.2, K.A. 042.
SCROPHULARIACEAE
Verbascum blattaria L.
Loc.4, K.A. 483.
Scrophularia umbrosa L.
Loc.3, K.A. 426; Loc.2, K.A. 437, 571. Euro.-Sib.
Linaria chalepensis (L.) Mill. var. **chalepensis**
Loc.6, K.A. 246. E. Medit.
L. pelisseriana (L.) Mill.
Loc.4, K.A. 179. Medit.
Kickxia elatine (L.) Dumort. subsp. **crinita** (Mabille) Greuter
Loc.2, K.A. 554. Medit.
Veronica triphyllos L.
Loc.7, K.A. 260.
V. persica Poiret
Loc.7, K.A. 142.
V. cymbalaria Bodard.
Loc.4, K.A. 126, 177, 187; Loc.5, K.A. 138; Loc.3, K.A. 326. Medit.
V. anagallis-aquatica L.
Loc.2, K.A. 306; Loc.3, K.A. 327;Loc.7, K.A. 330; Loc.5, K.A. 360; Loc.1, K.A. 445.
VERBENACEAE
Verbena officinalis L.
Loc.2, K.A. 036, 557; Loc.4, K.A. 497, 512; Loc.7, K.A. 543, 548.
Vitex agnus-castus L.
Loc.1, K.A. 027; Loc.5, K.A. 464; Loc.4, K.A. 477. Medit.
LAMIACEAE (LABIATAE)
Teucrium scordium L. subsp. **scordioides** (Schreber) Maire & Petitmengin
Loc.4, K.A. 502, 517, 518; Loc.2, K.A. 564. Euro.-Sib.
Lamium amplexicaule L.
Loc.3, K.A. 156; Loc.4, K.A. 192. Euro.-Sib.
L. purpureum L. var. **purpureum**
Loc.4, K.A. 125; Loc.2, K.A. 165; Loc.1, K.A. 217. Euro.-Sib.
Stachys cretica L. subsp. **smyrnaea**
Loc.1, K.A. 440. End. E. Medit.
S. annua (L.) L. subsp. **annua** var. **lycaonica** Bhattacharjee
Loc.7, K.A. 334. Ir.-Tur.
Melissa officinalis L. subsp. **altissima (**Sm.) Arcang.
Loc.4, K.A. 525. E. Medit.
Prunella vulgaris L.
Loc.3, K.A. 433; Loc.2, K.A. 439; Loc.1, K.A. 452, 552; Loc.7, K.A. 454; Loc.4, K.A. 480. Euro.-Sib.
Calamintha nepeta (L.) Savi subsp. **glandulosa** (Req.) P.W. Ball
Loc.4, K.A. 579.
Acinos rotundifolius Pers
Loc.6, K.A. 245.
Mentha pulegium L.
Loc.5, K.A. 536.
M. aquatica L.
Loc.4, K.A. 522, 588; Loc.7, K.A. 544; Loc.2, K.A. 560, 609; Loc.3, K.A. 587.
M. longifolia (L.) Huds. subsp. **typhoides** (Briq.) Harley var. **typhoides**
Loc.5, K.A. 534; Loc.2, K.A. 570.
Lycopus europaeus L.
Loc.2, K.A. 569. Euro.-Sib.
PLANTAGINACEAE
Plantago major L. subsp. **intermedia** (Gilib.) Lange
Loc.2, K.A. 048; Loc.7, K.A. 050.
P. lagopus L.
Loc.6, K.A. 248. Medit.
LAURACEAE
Laurus nobilis L.
Loc.2, K.A. 046; Loc.5, K.A. 089; Loc.7, K.A. 103; Loc.1, K.A. 117. Medit.
EUPHORBIACEAE
Mercurialis annua L.
Loc.6, K.A. 094, 597; Loc.1, K.A. 118; Loc.5, K.A. 135; Loc.4, K.A. 203.
Euphorbia dendroides L.
Loc.4, K.A. 509. Medit.
E. stricta L.
Loc.3, K.A. 149, 277; Loc.4, K.A. 193, 194, 479; Loc.1, K.A. 318, 419. Euro.-Sib.
E. helioscopia L.
Loc.4, K.A. 123, 124; Loc.2, K.A. 167.
E. peplus L. var. **peplus**
Loc.3, K.A. 108; Loc.2, K.A. 112; Loc.4, K.A. 128; Loc.5, K.A. 134; Loc.7, K.A. 140.
E. peplus L. var. **minima** DC.
Loc.5, K.A. 235; Loc.6, K.A. 244; Loc.3, K.A. 281; Loc.2, K.A. 309.
BUXACEAE
Buxus sempervirens L.
Loc.2, K.A. 030. Euro.-Sib.
MORACEAE

Ficus carica L. subsp. **carica**
Loc.4, K.A. 006; Loc.1, K.A. 446.
PLATANACEAE
Platanus orientalis L.
Loc.2, K.A. 411.
FAGACEAE
Quercus cocciferae L.
Loc.4, K.A. 007; Loc.2, K.A. 037. Medit.
RUBIACEAE
Sherardia arvensis L.
Loc.4, K.A. 190, 367; Loc.5, K.A. 230; Loc.6, K.A. 250; Loc.3, K.A. 400. Medit.
Galium debile Desf.
Loc.1, K.A. 442. Medit.
G. spurium L. subsp. **spurium**
Loc.5, K.A. 231; Loc.2, K.A. 297; Loc.4, K.A. 366. Euro.-Sib.
G. aparine L.
Loc.1, K.A. 320; Loc.3, K.A. 427; Loc.5, K.A. 539; Loc.2, K.A. 559.
G. murale (L.) All.
Loc.1, K.A. 012; Loc.4, K.A. 397. Medit.
Valantia hispida L.
Loc.4, K.A. 370. Medit.
MONOCOTYLEDONES
ALISMATACEAE
Alisma lanceolatum With.
Loc.2, K.A. 435; Loc.4, K.A. 485.
ARACEAE
Arisarum vulgare Targ.-Tozz. subsp. **vulgare**
Loc.4, K.A. 003, 067; Loc.5, K.A. 086. Medit.
LILIACEAE
Smilax excelsa L.
Loc.5, K.A. 054; Loc.1, K.A. 060; Loc.4, K.A. 065; Loc.2, K.A. 075, 077; Loc.3, K.A. 078, 585, 606; Loc.6, K.A. 099. Euro.-Sib.
Ruscus aculeatus L. var. **angustifolius** Boiss.
Loc.1, K.A. 023; Loc.4, K.A. 063; Loc.3, K.A. 080; Loc.5, K.A. 087; Loc.7, K.A. 105.
Asparagus acutifolius L.
Loc.2, K.A. 049, 159. Medit.
Scilla autumnalis L.
Loc.4, K.A. 494; Loc.1, K.A. 553. Medit.
Ornithogalum umbellatum L.
Loc.3, K.A. 145, 146; Loc.2, K.A. 158; Loc.4, K.A. 198; Loc.1, K.A. 213, 214; Loc.6, K.A. 247.
Muscari comosum (L.) Mill.
Loc.3, K.A. 289, 406. Medit.
IRIDACEAE
Iris xanthospuria B. Mathew & T. Baytop
Loc.4, K.A. 204; Loc.5, K.A. 237; Loc.7, K.A. 333; Loc.1, K.A. 417. End. E. Medit.
ORCHIDACEAE
Ophrys holoserica (Burm. fil.) Greuter subsp. **holoserica**
Loc.7, K.A. 339; Loc.4, K.A. 376. Medit.
O. apifera Hudson
Loc.5, K.A. 364; Loc.4, K.A. 388; Loc.3, K.A. 403, 405; Loc.2, K.A. 410.
Serapias politisii Renz.
Loc.4, K.A. 202, 389; Loc.5, K.A. 224; Loc.3, K.A. 278, 328. Medit.
Orchis palustris Jacq.
Loc.4, K.A. 361.
O. laxiflora Lam.
Loc.2, K.A. 308; Loc.1, K.A. 317; Loc.7, K.A. 341; Loc.4, K.A. 385. Medit.
Dactylorhiza iberica (Bieb. ex Willd.) Soo
Loc.3, K.A. 442a. E. Medit.
JUNCACEAE
Juncus littoralis C.A. Meyer
Loc.7, K.A. 139; Loc.3, K.A. 148, 276; Loc.1, K.A. 206; Loc.5, K.A. 234; Medit.
J. gerardi Loisel. subsp. **gerardi**
Loc.1, K.A. 415.
J. sparganiifolius Boiss. & Kotschy
Loc.3, K.A. 422. End. E. Medit.
J. articulatus L.
Loc.1, K.A. 218. Euro.-Sib.
CYPERCACEAE
Cyperus longus L.
Loc.4, K.A. 470; Loc.5, K.A. 537.
C. rotundus L.
Loc.2, K.A. 568.
Carex otrubae Podp.
Loc.1, K.A. 208, 209; Loc.2, K.A. 294, 613; Loc.5, K.A. 358. Euro.-Sib.
C. divulsa Stokes subsp. **divulsa**
Loc.5, K.A. 229, 236; Loc.7, K.A. 271. Euro.-Sib.
C. muricata L.
Loc.5, K.A. 357.
C. remota L.
Loc.4, K.A. 381. Euro.-Sib.
C. riparia Curtis
Loc.2, K.A. 612. Euro.-Sib.
C. pendula Huds.
Loc.2, K.A. 296; Loc.7, K.A. 342. Euro.-Sib.
C. flacca Schreb. subsp. **serrulata** (Biv.) Greuter
Loc.3, K.A. 150; Loc.2, K.A. 157; Loc.4, K.A. 174, 175; Loc.1, K.A. 219, 220; Loc.7, K.A. 274. Medit.
C. distans L.
Loc.5, K.A. 232; Loc.6, K.A. 252; Loc.7, K.A. 269; Loc.3, K.A. 282, 605; Loc.2, K.A. 611. Euro.-Sib.
POACEAE (GRAMINEA)
Brachypodium sylvaticum (Hudson) P. Beauv.
Loc.4, K.A. 008, 486; Loc.7, K.A. 052, 426; Loc.3, K.A. 425; Loc.2, K.A. 438, 610; Loc.6, K.A. 459. Euro.-Sib.
Trachynia distachya (L.) Link
Loc.6, K.A. 241. Medit.
Hendrardia persica (Boiss.) C.E. Hubbard var. **persica**
Loc.4, K.A. 526.
Bromus hordeaceus L. subsp. **hordeaceus**
Loc.4, K.A. 375.
B. sterilis L.
Loc.6, K.A. 256; Loc.4, K.A. 169.
Rostraria cristata (L.) Tzvelev var. **glabriflora** (Trautv.) M.Doğan
Loc.4, K.A. 368.
Polypogon monspeliensis (L.) Desf.
Loc.7, K.A. 331; Loc.1, K.A. 416.
Milium pedicellare (Bornm.) Roshev.
Loc.1, K.A. 001. Ir.-Tur.
Alopecurus myosuroides Huds. var. **myosuroides**
Loc.4, K.A. 170; Loc.1, K.A. 207, 210, 319, 321; Loc.2, K.A. 299. Euro.-Sib.
Cornucopiae cuculatum L.
Loc.1, K.A. 172. E. Medit.
Phleum subulatum (Savi) Aschers. & Graebn. subsp. **ciliatum** (Boiss.) C.J. Humphries
Loc.1, K.A. 489; Loc.4, K.A. 516; Loc.2, K.A. 562. E. Medit.
P. exaratum Hochst. ex Griseb. subsp. **exaratum**
Loc.4, K.A. 472.
Lolium rigidum Gaudin var. **rigidum**
Loc.1, K.A. 449.
Poa annua L.

Loc.4, K.A. 173, 178; Loc.7, K.A. 268, 273.
P. trivialis L.
Loc.3, K.A. 284, 399; Loc.2, K.A. 293, 295; Loc.1, K.A. 322; Loc.7, K.A. 338; Loc.4, K.A. 499.
Catabrosa aquatica (L.) P. Beauv.
Loc.1, K.A. 013; Loc.4, K.A. 496, 514a.
Cynosurus echinatus L.
Loc.6, K.A. 343. Medit.
Briza maxima L.
Loc.6, K.A. 239, 240.
B. minor L.
Loc.4, K.A. 384.
Parapholis incurva (L.) C.E. Hubbard
Loc.1, K.A. 550; Loc.4, K.A. 580.
Piptatherum miliaceum (L.) Cosson subsp. **miliaceum**
Loc.5, K.A. 531.
Phragmites australis (Cav.) Trin.
Loc.4, K.A. 523. Euro.-Sib.
Cynodon dactylon (L.) Pers. var. **dactylon**
Loc.1, K.A. 491; Loc.4, K.A. 498.
Setaria viridis (L.) P. Beauv.
Loc.4, K.A. 495, 582, 589.

4. Conclusions

The whole research areas correlate with the Mediterranean phytogeographical region is explained the most number of Mediterranean members; on the other hand, the members of Irano-Turanian and Euro-Siberian are much fewer than the Mediterranean members (Göktürk and Sümbül, 1997). Euro-Siberian elements have a higher percentage 26 (11.50%) than Irano-Turanian elements 3 (1.32%), because of local the humid climatic condition in *Liquidambar* forests. The distributions of the taxa in the phytogeographic regions are compared with the taxa in the neighbouring regions (Table 1).

Table 1. The comparison of the phytogeographic elements

Research area	This study	Fakir and Doğanoğlu (2003)	Güner et al. (1996)	Akman et al. (1992)
Mediterranean	56 (24.77)	28 (35.89)	380 (41.12)	31 (27.92)
Irano-Turanian	3 (1.32)	2 (3.84)	18 (1.94)	2 (1.80)
Euro-Siberian	26 (11.50)	---	38 (4.11)	17 (15.31)
Cosmopolits	141 (62.38)	48 (61.53)	452 (48.91)	61 (54.95)

The rate of endemism in the area is very low (2.65%). Only 6 species are endemic to Turkey. This is below the average for Turkey (33.5%). The main reason is that the edaphic, climatic and topographic properties of the region do not very much, and the altitude is limited to 0-102 m. It is well known that endemic species are mostly found on high mountains and in places where ecological diversity is rich.

The largest ten families are shown in Table 2. The first largest family is Poaceae with 24 species (10.61%). The second one is Asteraceae with 23 species (10.17%). The biggest family and resultant many members in the Flora of Turkey is Asteraceae which the greatest ecological tolerance and seeds that break up easily.

Table 2. The comparison of large families in research areas and neighbouring areas

Familia	This study	Fakir and Doğanoğlu (2003)	Güner et al. (1996)	Akman et al. (1992)
Poaceae	24 (10.61)	4 (5.12)	93 (10.06)	13 (11.71)
Asteraceae	23 (10.17)	4 (5.12)	91 (9.84)	9 (8.10)
Fabaceae	15 (6.63)	7 (8.97)	92 (9.95)	7 (6.30)
Lamiaceae	13 (5.75)	7 (8.97)	43 (4.65)	9 (9.10)
Apiaceae	11 (4.86)	2 (3.84)	44 (4.76)	2 (1.80)
Cyperaceae	10 (4.42)	1 (1.28)	24 (2.59)	9 (8.10)
Scrophulariaceae	9 (3.98)	1 (1.28)	29 (3.13)	5 (4.50)
Ranunculaceae	7 (3.09)	2 (3.84)	18 (1.94)	2 (1.80)
Rubiaceae	6 (2.65)	---	18 (1.94)	2 (1.80)
Caryophyllaceae	6 (2.65)	1 (1.28)	38 (4.11)	1 (---)

The most floristic studied two abundant families of the Turkish flora are Fabaceae and Asteraceae due to the variety of vegetation types, soil composition, climatic conditions, and topography (Fakir, 2006). Fabaceae with 15 species (6.63%) and Lamiaceae with 13 species (5.75%) follow them. In comparison with the Flora of Turkey (Davis et al., 1988), the order of the families is approximately the same in this study. Others in ten largest families are Apiaceae with 11 species (4.86%), Cyperaceae with 10 species (4.42%), Scrophulariaceae with 9 species (3.98%), Ranunculaceae with 7 species (3.09%), Rubiaceae 6 species (2.65%) and Caryophyllaceae with 6 species (2.65%). These largest ten families contain more than half of species (54.81%) in flora.

The genera with the highest number of taxa in the research areas shown in Table 3. The genus *Carex* L. had the highest number of taxa because the research areas are damp in character. *Carex* L., *Ranunculus* L., *Euphorbia* L. and *Trifolium* L. genera were dominant in our study as Güner et al. (1996) which carried Köyceğiz-Dalyan Special Protected Area. *Trifolium* L. was presented in all studies. *Juncus* L. was also common in other studies (Akman et al., 1992; Güner et al., 1996; Fakir and Doğanoğlu, 2003). One reason for the high number of *Juncus* is probably the existance of wet habitats.

Table 3. The comparison of large genera in research areas and neighbouring areas

Genus	This study	Fakir and Doğanoğlu (2003)	Güner et al. (1996)	Akman et al. (1992)
Carex	8	1	10	4
Trifolium	7	1	16	3
Ranunculus	6	---	11	1
Euphorbia	5	1	16	1
Vicia	4	1	10	---
Daucus	4	---	3	---
Veronica	4	---	7	1
Galium	4	---	10	2
Juncus	4	2	8	5
Crepis	3	---	10	1

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